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COMPLETE SPECIFICATION.

Improvements in or relating to the Manufacture of Moulds and Moulded Articles.

We, THOMAS WILLIAM PENRICE and REGINALD FREDERICK KNOWLSON, both British Subjects, and both of Harlington Works, Harlington Road, Sharpenhoe, Bedfordshire, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a process for the manufacture of moulds and moulded articles from powdered materials.

In the processes usually employed hitherto for manufacturing moulded articles by hot pressing of powders and sintering, the life of the moulds has been very short.

It is an object of the present invention to produce moulded articles having the same shape as a master shape and moulds in which these moulded articles can be made. Preferably the master shape is made of compressed carbon or graphite which can easily be machined to the desired shape and which can be used for the manufacture of a large number of moulded articles.

According to the process of the present invention for the manufacture of moulds a master shape, preferably made of compressed carbon or graphite, is impressed in a powder of a refractory metal, carbide, nitride or boride, or other powder capable of being sintered, the powder is partially sintered by heat and pressure and the master shape removed.

The invention also includes a process for the manufacture of moulded articles in which a powder capable of being sintered under pressure is introduced into the mould prepared as described above and the powder sintered by heat and pressure without further compacting of the mould to produce the moulded article.

According to a preferred embodiment of the invention a master shape of compressed carbon or graphite is impressed into titanium carbide powder held in a suitably shaped carbon container by the application of pressure at a temperature of between 1600° C. and 2000° C. The grain size, purity and surface condition of the titanium carbide used is such that a partially sintered product is obtained. The temperature employed will depend mainly upon the grain size, the higher temperatures being used for the coarser powders, other things being equal. The master shape is then withdrawn leaving a corresponding mould of titanium carbide.

This mould may now be filled with hard metal powder, e.g. a mixture of tungsten carbide powder with a minor proportion, e.g. 6%, of cobalt powder, and pressure is again applied at high temperature to sinter the hard metal. This sintered hard metal is the same shape as the original master component.

The temperature and pressure chosen to sinter the hard metal must be such that no further compacting of the titanium carbide takes place. Using the same pressure that was used to form the mould at a lower temperature of 1350° C. to 1450° C. will produce the desired result.

The titanium carbide of the mould may adhere to the required hard metal component. The partially sintered titanium carbide can easily be removed by mechanical abrasion, e.g. by shot-blasting. The hard metal component will remain undamaged.

The original master shape can then be used to repeat the process as required.

It should be understood that a component of the same material as the mould can be produced, e.g. coarse grain titanium carbide can be sintered at a temperature of 2000° C. using three tons per square inch pressure to produce a suitable mould.

A component in pure fine grain titanium carbide can then be made in this mould by sintering at the same pressure, but using a temperature of between 1450° C. and

[*Price* 2*s*. 8*d*.]

Price 4s 6d.

1600° C. The component produced will be considerably harder than the mould. The component can again be cleaned by shot-blasting.

The master component instead of being of carbon or graphite can be a sintered product made from a refractory material provided that it remains undamaged under the conditions used when sintering the mould.

An improved surface finish of the moulded article may be obtained by filling any slight pores in the mould surfaces with fine graphite powder or other refractory material.

A difficult shape can thus be reproduced by this process of double moulding without resort to machining each individual mould.

An example illustrating how the invention may be carried into effect will now be given in relation to the manufacture of turbine blades.

Turbine blades have been previously made by sintering under pressure, but they usually have a complex shape and in order that they may be removed from the mould in which they are made the mould is made in a number of pieces. The mould or components of the mould are generally prepared by machining and can only be used for a limited number of pressings.

According to the present invention the mould for the production of the turbine blade was made by using a master shape of graphite which was impressed into titanium carbide powder disposed in a carbon container using a pressure of 3 tons per square inch and a temperature of 2000° C. The master shape was then withdrawn and used again.

Into the mould of partially sintered titanium carbide thus prepared there was introduced a powder consisting of titanium carbide containing 20% by weight of cobalt powder. The material in the mould was then sintered at three tons per square inch at 1450° C. to produce a densely sintered turbine blade without any further compacting of the mould. The mould was removed by mechanical abrasion but it will be understood that a composite mould, i.e. a mould consisting of a plurality of parts, may be used, in which case the mould may be removed by dismantling.

Similar results may be obtained by replacing the titanium carbide both in the preparation of the moulds and the moulded articles wholly or in part by the metal itself, or its nitrides, boride or oxide or mixtures of these substances.

What we claim is:—

1. A process for the manufacture of moulds wherein a master shape is impressed in a powder of a refractory metal, carbide, nitride or boride or other powder capable of being sintered, the powder is partially sintered by heat and pressure and the master shape removed.

2. A process as claimed in Claim 1 wherein the master shape is made of compressed carbon or graphite.

3. A process as claimed in Claim 1 or 2 wherein the refractory carbide is titanium carbide.

4. A process as claimed in Claim 3 wherein the sintering is effected at a temperature of between 1600° C. and 2000° C.

5. Moulds when manufactured by the process claimed in any one of the preceding claims.

6. A process for the manufacture of moulded articles wherein a powder capable of being sintered under pressure is introduced into a mould claimed in Claim 5 and the powder is sintered by heat and pressure without further compacting of the mould to produce the moulded articles.

7. A process as claimed in Claim 6 wherein the powder capable of being sintered is a tungsten carbide powder.

8. A process as claimed in Claim 7 wherein the sintering is effected at a temperature of between 1350° C. and 1450° C.

9. A process as claimed in Claim 6 wherein the powder capable of being sintered is a titanium carbide powder.

10. A process as claimed in Claim 9 wherein the sintering is effected at a temperature of between 1450° C. and 1600° C.

11. A process as claimed in any one of the preceding Claims 7 to 10 wherein the powder contains a minor proportion by weight of cobalt powder.

12. A process for the manufacture of turbine blades by moulding substantially as described with reference to the Example given.

13. Moulded articles when manufactured by the process claimed in any one of the preceding Claims 6 to 12.

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PROVISIONAL SPECIFICATION.

Improvements in or relating to the Manufacture of Moulds and Moulded Articles.

We, THOMAS WILLIAM PENRICE and REGINALD FREDERICK KNOWLSON, both British Subjects, and both of Harlington Works, Harlington Road, Sharpenhoe, Bedfordshire, do hereby declare the nature of this invention to be as follows:—

This invention relates to a process for the manufacture of moulds and moulded articles from powdered materials.

In the processes usually employed hitherto for manufacturing moulded articles by hot pressing of powders and sintering, the life of the moulds has been very short.

It is an object of the present invention to produce moulded articles having the same shape as a master shape and moulds in which these moulded articles can be made. Preferably the master shape is made of compressed carbon or graphite which can easily be machined to the desired shape and which can be used for the manufacture of a large number of moulded articles.

According to the process of the present invention for the manufacture of moulds a master shape, preferably made of compressed carbon or graphite, is impressed in a powder of a refractory metal, carbide, nitride or boride, or other powder capable of being sintered, the powder is partially sintered by heat and pressure and the master shape removed.

The invention also includes a process for the manufacture of moulded articles in which a powder capable of being sintered under pressure is introduced into the mould prepared as described above and the powder sintered by heat and pressure without further compacting of the mould to produce the moulded article.

According to a preferred embodiment of the invention a master shape of compressed carbon or graphite is impressed into titanium carbide powder held in a suitably shaped carbon container by the application of pressure at a temperature of between 1600° C. and 2000° C. The grain size, purity and surface condition of the titanium carbide used is such that a partially sintered product is obtained. The temperature employed will depend mainly upon the grain size, the higher temperatures being used for the coarser powders, other things being equal. The master shape is then withdrawn leaving a corresponding mould of titanium carbide.

This mould may now be filled with hard metal powder, e.g. a mixture of tungsten carbide powder with a minor proportion, e.g. 6%, of cobalt powder, and pressure is again applied at high temperature to sinter the hard metal. This sintered hard metal is the same shape as the original master component.

The temperature and pressure chosen to sinter the hard metal must be such that no further compacting of the titanium carbide takes place. Using the same pressure that was used to form the mould at a lower temperature of 1350° C. to 1450° C will produce the desired result.

The titanium carbide of the mould may adhere to the required hard metal component. The partially sintered titanium carbide can easily be removed by mechanical abrasion, e.g. by shot-blasting. The hard metal component will remain undamaged.

The original master shape can then be used to repeat the process as required.

It should be understood that a component of the same material as the mould can be produced, e.g. coarse grain titanium carbide can be sintered at a temperature of 2000° C. using three tons per square inch pressure to produce a suitable mould.

A component in pure fine grain titanium carbide can then be made in this mould by sintering at the same pressure, but using a temperature of only 1600°C. The component produced will be considerably harder than the mould. The component can again be cleaned by shot-blasting.

The master component instead of being of carbon or graphite can be a sintered product made from a refractory material provided that it remains undamaged under the conditions used when sintering the mould.

Dated the 12th day of September, 1949.

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